

val commences his residence in the hot season, and the skin, with the action of which that of the liver is vicarious, acts freely for a continuance. If he begins his residence in the cold season, he may escape any over-action of the liver altogether; or if it occurs, it will be less in degree, and will be more tractable than in the other case. This increased action is of the nature of functional derangement, and is no doubt attributable to hyperæmia of the organ. This causes at first increased secretion simply, with sympathetic functional derangement of the stomach, and probably of the skin, lungs, &c. If this be speedily checked, and everything is favourable as regards season, and non-malarious condition of the atmosphere, &c., things will return to their original state; otherwise, structural degeneration may occur; but more often than that, there remains a functional derangement of the liver, involving changes of other functions; particularly those with which the liver sympathizes; alteration of the constitution of the blood, &c. The derangement is often of such a serious nature, that a proper acclimatization in India is rendered impossible, and change of climate of some kind becomes necessary. In milder cases, the over-action of the liver is succeeded by a corresponding torpor; and this again, while the constitution retains its vigour, by a fit of over-excitement; these opposite conditions alternating for some time. Consequently, there is always an irregular and vitiated state of the biliary secretion, with its necessary concomitants, impairment of the nutritive and nervous functions of the body generally. This state of hyperæmia of the liver, although produced in the first instance by increased temperature, is kept up very often by local influences, such as produce malaria. In fact, it exists to a greater extent in comparatively cool weather, as in the rainy and cold seasons in India, than in the hottest. In few cases, however, would the exciting cause act, but for the predisposition caused by the increased temperature. Again, in addition to heat, it seems that there must be some influence which arrests the action of the skin, for it has been remarked that in seasons in which the heat has been great, but without moisture, and consequently in which there has been no impediment to a very free action of the skin, there has been an unusual freedom from congested livers. There is no doubt, however, that long-continued heat, even if dry, will of itself, under certain circumstances, produce a state of hyperæmia.

Acute hyperæmia, or inflammation, often, according to the nature of the exciting causes of disease applied, leads to structural changes, abscess, fatty and other degenerations, &c.; with these may be conjoined the effects of fevers, dysentery, dangerous affections of the kidneys, spleen, &c. Sometimes, there is a protracted condition of chronic hyperæmia, which is too often known only by its effects. The patient experiences nothing perhaps but a general feeling of discomfort, and a state of torpor of the mind and of the functions of the nervous system, and of the principal organs, while organic changes are taking place, which will often be found to be irremediable. Frequently the disease commences in a state of sub-acute hyperæmia, in which there is pain, but not of a severe character, little disturbance of the stomach, only torpor of the chylipoietic functions, with some degree of pyrexia; and this state may merge, according to the nature of any reapplied exciting cause, such as errors in diet, the influence of heat or cold, or wet, or any combinations of these on the patient's peculiar constitution, whether irritable or torpid, into an acute or chronic state of inflammation or hyperæmia. The final results are increase of volume of the liver, sometimes to an enormous extent, or hepatic abscess or exhausting diseases of the bowels; the only chance for saving life being an early change of air, the removal of a European to his native, or at any rate, a milder climate, being, with some exceptions, the most likely means to lead to a restoration of health."

42. *Action of Water on Lead.*—Dr. B. W. RICHARDSON makes (*Med. Times and Gazette*, Oct. 29, 1864) some very interesting and important remarks on this subject. He observes:—

"Until recently the popular creed, professional as well as public, on this subject has been that—

"1. Pure or soft waters alone act¹ on lead, and do so in proportion to their purity or softness.

"2. A minute proportion of certain neutral salts in water prevents its action on lead.

"3. Hence hard or impure waters do not act on lead, and may be safely stored in leaden cisterns and conveyed through leaden pipes.

"In 1858, however, Dr. Lauder Lindsay, of Perth, laid before the British Association² the records of a series of experiments and observations made by him on this important subject during the previous year. His main or general results were tabulated in the following series of propositions,³ viz., that—

"1. Under certain circumstances pure or soft waters *do not* act on lead.

"This was well illustrated by the results of the inquiry instituted in 1854–5 by the Town Council of Glasgow, in connection with the proposed water supply to that city from Loch Katrine. This inquiry cost £5000, and was of the most extensive kind and exhaustive character. It proved *inter alia* that Loch Katrine and other equally pure or soft waters (containing under 2 or 2½ grs. per gallon of solid matter, with a hardness of 0.6 to 0.8 of Clarke's scale) exerted, under given circumstance, no deleterious action on lead.⁴

"2. Hard or impure waters, sometimes containing abundance of the very salts which are generally supposed to be most preservative or protective, *do act* on lead, and with the same rapidity and efficiency as pure or soft waters. This was illustrated by the destruction of lead cisterns, through the erosive action of hard water, in the Murray Royal Institution (an hospital or retreat for the insane of the middle classes), near Perth, of which Dr. Lindsay is the physician. This early destruction of lead first directed his attention to the subject.⁵

"3. We are in possession of no satisfactory information anent the causes of the varying action, under different circumstances, of waters on lead; information, that is, which is of any practical use in assisting either in predicating or preventing lead-erosion or lead-contamination.

"4. *Experimentation on the small scale*, and for short periods, is most fallacious, and frequently dangerous in regard to the practical conclusions thence to be drawn.

"5. Contamination of water, both hard and soft, impure and pure, by lead is, in all parts of the kingdom, and under every variety of circumstances, the cause or source of various obscure diseases of man (and also, doubtless, of the lower animals), of the nature especially of dyspepsia and colic. This proposition was abundantly proved by cases of minor diseases induced by lead-contamination of various of the hard or impure waters of London.

"6. So uncertain is the action of water on lead, so impossible is it to predicate the nature or extent of that action under the varying mechanical and chemical conditions of water supply of houses and towns, so difficult is it to prevent the possible dangers, so numerous and excellent are the substitutes⁶ that may be

¹ When not otherwise specially explained, this action on lead refers only to that which, by virtue of its nature or extent, renders drinking or cooking waters dangerous or deleterious to men.

² Chemical Section—Leeds Meeting, September 24, 1858.

³ These will be found given in his paper "On the Action of Hard Waters upon Lead," in the *Edinburgh New Philosophical Journal* for April, 1859.

⁴ Papers on the "Glasgow Water Works," read before the Institution of Engineers in Scotland, Session 1863–4, by Jas. M. Gole, C.E., and Engineer to the said Works. Glasgow, 1864. p. 22.

⁵ *Vide* the published Medical Reports of said Institution for the years 1859 (p. 36) and 1860 (p. 14).

⁶ The substitutes in question are of very various kinds. Those most commonly used seem to be—for piping—iron or lead tubes, protected by various innocuous compositions, metallic or otherwise. In the great brewing establishment of Messrs. Allsopp & Sons, at Burton-on-Trent, enamelled pipes have been laid throughout their premises. These are iron tubes, enamelled under the patents of Mr. Paris. The enamel, or fused glass, is applied both externally and internally, so that the iron is completely encased; it is incorporated with the metal while it is nearly at

provided for lead in the construction of cisterns and pipes, that it is desirable henceforth to *abolish the use of lead as a material for the conveyance or storage of water.*

"This *practical* proposition, to which all the others converge or lead, is now being adopted and acted upon by all our most competent and eminent authorities.

"The Royal Victoria Military Hospital at Netley, which ought to be the embodiment of all modern progress and discovery in sanitary science and hygiene in their applications to the construction of human dwellings, uses *no lead* in its water cisterns or pipes. A writer in *Good Words*¹ says of this hospital: 'The *water supply* has been carefully attended to, and to prevent the possibility of patients suffering from *lead contamination*, not an atom of that metal has been used in the construction either of the pipes or cisterns. The former are made of block *tin*, and cost £9000. It would be well for the health of the community if in our private houses similar precautions were used.

"The Commissioners in Lunacy for Scotland in their regulations anent the construction of lunatic asylums, remark in regard to water supply:² 'It is of the utmost importance that there should be a constant and ample supply of *good water*, of which a *careful analysis should be made, with a view to determine the proper materials for pipes and reservoirs*, and also in order to ascertain its fitness for the purposes of drinking and washing.' The reporters add: '*Lead is an objectionable material for pipes and reservoirs as adulterating the water.*' Dr. Hassall, the 'Analytical Commissioner' of the *Lancet*, and the author of the well-known standard work on 'Food and its Adulterations,' says: 'From the number of samples of water I have received containing lead, I am induced to believe that that metal is more frequently introduced into the system in this way than is commonly suspected. Indeed, so many well-ascertained cases of *lead poisoning*, arising from the use of water contaminated with it, have occurred, that I am of opinion that the *use of lead for the storage and conveyance of water ought to be entirely discarded*, especially in the cases of small towns and single houses.'³

"Again, the late Dr. Dundas Thomson, President of the Metropolitan Association of Medical Officers of Health, who had for many years given, as a chemist, great attention to the subject of water supply, and than whom, on such a subject, there are no more competent authorities, remarks: '*It is impossible too strongly to condemn the use of lead pipes and cisterns. They should never be used for conducting and retaining water for drinking and culinary purposes. It is difficult to understand the origin of the employment of a poisonous metal for domestic use.* But its disuse must depend upon the substitution of the builder or iron pipe fitter for the plumber, who has too long monopolized the manufacture of this noxious form of cistern.'⁴

"The Americans apparently attribute a greater value to this subject than we do, having devoted a goodly volume to the now bulky evidence *pro* and *con*.⁵

"In 1859-60 the great lead and water question was the subject of much public discussion in the columns of the *Times*. The result was a general feeling that the public safety lay in the *abolition of lead in the construction of cisterns and pipes for water supply*—some writers going so far as to recommend a *prohibition by Government* of such use of lead."⁶

a white heat. The same enamel may be applied as a coating for the surface of vessels used for culinary or domestic purposes.—*Builder*, April, 1860.

¹ Article on the Victoria Hospital, *Good Words*, December, 1863, p. 883.

² "First Annual Report (1859):" Appendix C., No. 1, section 6, and No. 2, section 30, pp. 115 and 118.

³ On "Unsuspected Sources of Lead Poisoning," *Lancet*, April 7, 1860.

⁴ On the Proper Sources of Waters for Domestic Supply, *Transactions of the National Association for the Promotion of Social Science*, 1862, p. 615.

⁵ "Collection of Reports [Condensed] and Opinions of Chemists in regard to the Use of Lead Pipe for Service Pipe in the Distribution of Water for the Supply of Cities." New York. 8vo., cloth, pp. 343, 9s. London: Trübner & Co. 1859.

⁶ *Times*, October 1, 1859.